WHAT IS CLAIMED IS:

| 1 | 1. An isolated protein comprising a HER-2/neu extracellular domain |
|------------|--|
| 2 | fused to a HER-2/neu phosphorylation domain, wherein the profein is capable of |
| 3 | producing an immune response in a warm-blooded animal. |
| | |
| 1 | 2. The protein of claim 1, wherein the protein has a sequence at least |
| 2 | 80% identical to the sequence of SEQ ID NO:6, or wherein the protein comprises a |
| 3 | sequence at least 80% identical to the sequence of SEQ ID NO:3 fused to a sequence at |
| 4 | least 80% identical to the sequence of SEQ ID NO:4. |
| 1 | 3. The protein of claim 1, wherein the protein comprises a sequence at |
| 2 | least 80 % identical to the sequence of SEQ ID NO:3 directly fused to an amino acid |
| 3 | sequence at least 80% identical to the sequence inclusive of Gln 991 to Val 1256 of SEQ |
| 4 | ID NO:2, or wherein the protein comprises a sequence at least 80 % identical to the |
| <u>/</u> 5 | sequence of SEQ ID NO:3 fused to the amino acid sequence at least 80% identical to the |
| 6 | sequence inclusive of Gln 991 to Val 1256 of SEO ID NO:2. |
| 1 | 4. The protein of claim 1, wherein the protein comprises a sequence at |
| 2 | least 80% identical to the sequence of SEQ ID NO:8 directly fused to a sequence at least |
| 3 | 80% identical to the sequence of SEQ ID NO:4, or wherein the protein comprises a |
| 4 | sequence at least 80% identical to the sequence of SEQ ID NO:8 fused to a sequence at |
| 5 | least 80% identical to the sequence of SEQ ID NO:4. |
| 1 | 5. The protein of claim 1, wherein the protein comprises a sequence at |
| 2 | least 80% identical to the sequence of SEQ ID NO:8 directly fused to the amino acid |
| 3 | sequence inclusive of Gln 991 to Val 1256 of SEQ ID NO:2, or wherein the protein |
| 4 | comprises a sequence at least 80% identical to the sequence of SEQ ID NO:8 fused to a |
| 5 | sequence at least 80% identical to the amino acid sequence inclusive of Gln 991 to Val |
| 6 | 1256 of SEQ ID NO:2. |
| 1 | 6. The protein of claim 1, wherein the HER-2/neu extracellular |
| 2 | domain is fused to the HER-2/neu phosphorylation domain via a chemical linker. |
| 1 | 7. The protein of claim 6, wherein the chemical linker is an amino |
| 2 | acid linker. |

| 1 | | 8. | A nucleic acid molecule encoding the protein of claim 1. |
|-----|-----------------|-----------|--|
| 1 | | 9. | A viral vector comprising a polynucleotide sequence encoding the |
| 2 | protein of clai | im'1. | |
| 1 | . ' | 10. | A pharmaceutical composition comprising the protein of claim 1, |
| 2 | and a pharma | ceutical | ly acceptable carrier or diluent. |
| 1 | i i | 11. | The pharmaceutical composition of claim 10, wherein the |
| 2 | pharmaceutic | al comp | osition is a vaccine. |
| 1 | | 12. | The pharmaceutical composition of claim 10, further comprising an |
| 2 | immunostimu | ılatory s | substance. |
| 1 . | | 13. | The pharmaceurical composition of claim 12, wherein the protein is |
| 2 | presented in a | ın oil-in | -water emulsion |
| 1 | | 14. | The pharmaceutical composition of claim 12, wherein the |
| 2 | immunostimu | ılatory s | substance is SBAS2, 3D-MPL, QS21, or a combination of 3D-MPL |
| 3 | and QS21. | | |
| 1 | | 15. | A pharmaceutical composition comprising the nucleic acid |
| 2 | molecule of c | laim 8, | and a pharmaceutically acceptable carrier or diluent. |
| 1 | | 16. | The pharmaceutical composition of claim 15, wherein the |
| 2 | pharmaceutic | al comp | position is a vaccine. |
| | | | |
| 1 | | 17. | The pharmaceutical composition of claim 15, further comprising an |
| 2 | immunostimu | ılatory s | substande. |
| 1 - | | 18. | The pharmaceutical composition of claim 15, wherein the nucleic |
| 2 | acid molecule | is a Di | NA molecule. |
| | | | |
| 1 | | 19. | A method for eliciting or enhancing an immune response to HER- |
| 2 | _ | | thod comprising the step of administering to a warm-blooded animal |
| 3 | the protein of | claim 1 | Lin an amount effective to elicit or enhance the immune response. |

| | · |
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| 1 | 20. The method of claim 19, wherein the protein is administered in the |
| 2 | form of a vaccine. |
| 1 | 21. A method for eliciting or enhancing an immune response to HER- |
| 1 | 2/neu protein, the method comprising the step of administering to a warm-blooded animal |
| 2 | |
| 3 | the nucleic acid molecule of claim 8 in an amount effective to elicit or enhance the |
| 4 | immune response. |
| 1 | 22. The method of claim 21, wherein the nucleic acid molecule is in |
| 2 | the form of a vaccine. |
| | |
| 1 | 23. The method of claim 21, wherein the step of administering |
| 2 | comprises transfecting cells of the warm-blooded animal ex vivo with the nucleic acid |
| 3 | molecule and subsequently delivering the transfected cells to the warm-blooded animal. |
| | 24. A method for eligiting or enhancing an immune response to HER- |
| -1 | 1 1 1 2 |
| 2 | 2/neu protein, the method comprising the step of administering to a warm-blooded animal |
| 3 | the viral vector of claim 9 in an amount effective to elicit or enhance the immune |
| 4 | response. |
| 1 | 25. The method of claim 24, wherein the step of administering |
| 2 | comprises infecting cells of the warm-blooded animal ex vivo with the viral vector and |
| 3 | subsequently delivering the infected cells to the warm-blooded animal. |
| | |
| 1 | 26. An isolated protein comprising a HER-2/neu extracellular domain |
| 2 | fused to a fragment of the HER-2/neu phosphorylation domain, wherein the protein is |
| 3 | capable of producing an immune response in a warm-blooded animal. |
| 1 | 27. The protein of claim 26, wherein the protein has a sequence at least |
| 2 | 80% identical to the sequence of SEQ ID NO:7, or wherein the protein comprises a |
| 3 | sequence at least 80% identical to the sequence of SEQ ID NO:3 fused to a sequence at |
| 4 | least 80% identical to the sequence of SEQ ID NO:5. |
| | as a sequence |
| 1 | 28. The protein of claim 26, wherein the protein comprises a sequence |
| 2 | at least 80% identical to the sequence of SEQ ID NO:3 directly fused to a sequence at |
| 3 | least 80% identical to the amino acid sequence inclusive of Gln 991 to Arg 1049 of SEQ |

| 4 | ID NO:2, or wherein the protein comprises a sequence at least 80% identical to the |
|---|---|
| 5 | sequence of SEQ ID NO:3 fused to a sequence at least 80% identical to the amino acid |
| 6 | sequence inclusive of Gln 991 to Arg 1049 of SEQ ID NO:2. |
| 1 | 29. The protein of claim 26, wherein the protein comprises a sequence |
| 2 | at least 80% identical to the sequence of SEQ ID NO:8 directly fused to a sequence at |
| 3 | least 80% identical to the sequence of SEQ ID N ϕ :5, or wherein the protein comprises a |
| 4 | sequence at least 80% identical to the sequence of SEQ ID NO:8 fused to a sequence at |
| 5 | least 80% identical to the sequence of SEQ ID NO:5. |
| 1 | 30. The protein of claim 26, wherein the protein comprises a sequence |
| 2 | at least 80% identical to the sequence of SEQ ID NO:8 directly fused to a sequence at |
| 3 | least 80% identical to the amino acid sequence inclusive of Gln 991 to Arg 1049 of SEQ |
| 4 | ID NO:2, or wherein the protein comprises a sequence at least 80% identical to the |
| 5 | sequence of SEQ ID NO:8 fused to a sequence at least 80% identical to the amino acid |
| 6 | sequence inclusive of Gln 991 to Arg 1049 of SEQ ID NO:2. |
| 1 | 31. The protein of claim 26, wherein the HER-2/neu extracellular |
| 2 | domain is fused to the fragment of the HER-2/neu phosphorylation domain via a chemical |
| 3 | linker. |
| 1 | 32. The protein of claim 31, wherein the chemical linker is an amino |
| 2 | acid linker. |
| 1 | 33. A nucle cacid molecule encoding the protein of claim 26. |
| 1 | 34. A viral vector comprising a polynucleotide sequence encoding the |
| 2 | protein of claim 26. |
| 1 | 35. A pharmaceutical composition comprising the protein of claim 26, |
| 2 | and a pharmaceutically acceptable carrier or diluent. |
| 1 | 36. The pharmaceutical composition of claim 35, wherein the |
| 2 | pharmaceutical composition is a vaccine. |
| - | |
| 1 | 37. The pharmaceutical composition of claim 35, further comprising an |
| _ | : |

| 1 | 38. The pharmaceutical composition of claim 37, wherein the protein is |
|----------|--|
| 2 | presented in an oil-in-water emulsion. |
| 1 | 39. The pharmaceutical composition of claim 37, wherein the |
| 2 | immunostimulatory substance is SBAS2, 3D-MPL, QS21, or a combination of 3D-MPL |
| 3 | and QS21. |
| | to the musicing the musicing the musicing and |
| 1 | 40. A pharmaceutical composition comprising the nucleic acid |
| 2 | molecule of claim 33, and a pharmaceutically acceptable carrier or diluent. |
| 1 | 41. The pharmaceutical composition of claim 40, wherein the |
| 2 | pharmaceutical composition is a vaccine. |
| | |
| 1 | 42. The pharmaceutical composition of claim 40, further comprising as |
| 2 | immunostimulatory substance. |
| — | 43. The pharmaceutical composition of claim 40, wherein the nucleic |
| 1 | acid molecule is a DNA molecule. |
| 2 | acid molecule is a DIVA molecule. |
| 1 | 44. A method for eliciting or enhancing an immune response to HER- |
| 2 | 2/neu protein, the method comprising the step of administering to a warm-blooded anima |
| 3 | the protein of claim 26 in an amount effective to elicit or enhance the immune response. |
| | |
| 1 | 45. The method of claim 44, wherein the protein is administered in the |
| 2 | form of a vaccine. |
| 1 | 46. A method for eliciting or enhancing an immune response to HER- |
| 1 | 2/neu protein, the method comprising the step of administering to a warm-blooded anima |
| 2 | the nucleic acid molecule of claim 33 in an amount effective to elicit or enhance the |
| 3 | |
| 4 | immune response. |
| 1 | 47. The method of claim 46, wherein the nucleic acid molecule is in |
| 2 | the form of a vaccine. |
| 1 | 48. The method of claim 46, wherein the step of administering |
| 2 | comprises transfecting cells of the warm-blooded animal ex vivo with the nucleic acid |
| _ | malacula and subsequently delivering the transfected cells to the warm-blooded animal. |

| 1 | 49. A method for eliciting or enhancing an immune response to HER- |
|----|---|
| 2 | 2/neu protein, the method comprising the step of administering to a warm-blooded animal |
| 3 | the viral vector of claim 34 in an amount effective to elicit or enhance the immune |
| 4 | response. |
| 1 | 50. The method of claim 49, wherein the step of administering |
| 2 | comprises infecting cells of the warm-blooded animal ex vivo with the viral vector and |
| 3 | subsequently delivering the infected cells to the warm-blooded animal. |
| 1 | 51. An isolated protein comprising a HER-2/neu extracellular domain |
| 2 | fused to a HER-2/neu intracellular domain, wherein the protein is capable of producing an |
| 3 | immune response in a warm-blooded animal. |
| 1 | 52. The protein of claim 51, wherein the protein comprises a sequence |
| 2 | at least 80% identical to the sequence of EQ ID NO:3 fused directly to a sequence at |
| 3/ | least 80% identical to the amino acid sequence inclusive of Lys 676 to Val 1255 in SEQ |
| .4 | ID NO:1, or wherein the protein compreses a sequence at least 80% identical to the |
| 5 | sequence of SEQ ID NO:3 fused to a sequence at least 80% identical to the amino acid |
| 6 | sequence inclusive of Lys 676 to Val 1255 of SEQ ID NO:1 via at least one of a chemical |
| 7 | or amino acid linking group. |
| 1 | 53. The protein of claim 51, wherein the protein comprises a sequence |
| 2 | at least 80% identical to the sequence of SEQ ID NO:3 directly fused to a sequence at |
| 3 | least 80% identical to the amino acid sequence inclusive of Lys 677 to Val 1256 of SEQ |
| 4 | ID NO:2, or wherein the protein comprises a sequence at least 80% identical to the |
| 5 | sequence of SEQ ID NO:3 fused to a sequence at least 80% identical to the amino acid |
| 6 | sequence inclusive of Lys 677 to Val 1256 of SEQ ID NO:2 via at least one of a chemical |
| 7 | or amino acid linking group. |
| 1 | 54. The protein of claim 51, wherein the protein comprises a sequence |
| 2 | at least 80% identical to the sequence of SEQ ID NO:8 directly fused to a sequence at |
| 3 | least 80% identical to the amino acid sequence inclusive of Lys 676 to Val 1255 of SEQ |
| 4 | ID NO:1, or wherein the protein comprises a sequence at least 80% identical to the |
| 5 | sequence of SEQ ID NO:8 fused to a sequence at least 80% identical to the amino acid |

| 6 | sequence inclusive o | f Lys 676 to Val 1255 of SEQ ID NO:1 via at least one of a chemical | |
|-----|------------------------------|--|--|
| 7 | or amino acid linking | g group. | |
| 1 | ·55. | The protein of claim 51, wherein the protein comprises a sequence | |
| 2 | at least 80% identica | I to the sequence of SEQ ID NO 8 directly fused to a sequence at | |
| 3 | least 80% identical t | o the amino acid sequence inclusive of Lys 677 to Val 1256 of SEQ | |
| 4 | ID NO:2, or wherein | the protein comprises a sequence at least 80% identical to the | |
| 5 | sequence of SEQ ID | NO:8 fused to a sequence at least 80% identical to the amino acid | |
| 6 | sequence inclusive of | of Lys 677 to Val 1256 of SEQ ID NO:2 via at least one of a chemical | |
| 7 | or amino acid linking group. | | |
| 1 | 56. | The protein of claim 51/wherein the HER-2/neu extracellular | |
| 2 | domain is fused to the | ne HER-2/neu intracellular domain via a chemical linker. | |
| 1/ | <i>/</i> 57. | The protein of claim 56, wherein the chemical linker is an amino | |
| 2 | acid linker. | | |
| 1 | 58. | A nucleic acid molecule encoding the protein of claim 51. | |
| 1 | 59. | A viral vector comprising a polynucleotide sequence encoding the | |
| 2 | protein of claim 51. | | |
| 1 | 60. | A pharmaceutical composition comprising the protein of claim 51, | |
| 2 . | and a pharmaceutica | ally acceptable carrier or diluent. | |
| 1 | 61. | The pharmaceutical composition of claim 60, wherein the | |
| 2 | pharmaceutical com | position is a vaccine. | |
| 1 | 62. | The pharmaceutical composition of claim 60, further comprising an | |
| 2 | immunostimulatory | | |
| 1 | 63. | The pharmaceutical composition of claim 62, wherein the protein is | |
| 2 | presented in an oil-i | n-water emulsion. | |
| 1 | . 64. | The pharmaceutical composition of claim 62, wherein the | |
| 2 | immunostimulatory | substance is SBAS2, 3D-MPL, QS21, or a combination of 3D-MPL | |
| 3 | and OS21 | | |

| 1 | 65. | A pharmaceutical composition comprising the nucleic acid |
|-----|-------------------------|--|
| 2 | molecule of claim 58 | , and a pharmaceutically acceptable carrier or diluent. |
| | | |
| 1 | 66. | The pharmaceutical composition of claim 65, wherein the |
| 2 | pharmaceutical comp | osition is a vaccine. |
| | | |
| 1 | 67. | The pharmaceutical composition of claim 65, further comprising an |
| 2 | immunostimulatory s | substance. |
| , | 68. | The pharmaceutical composition of claim 65, wherein the nucleic |
| 1 . | | |
| 2 | acid molecule is a DI | NA molecule. |
| 1 | 69. | A method for eligiting or enhancing an immune response to HER- |
| 2 | | ethod comprising the step of administering to a warm-blooded animal |
| | | 51 in an amount effective to elicit or enhance the immune response. |
| 3 | the protein of claim | of the an amount effective to enert of eminines the mandie response. |
| 1 | 70. | The method of claim 69, wherein the protein is administered in the |
| 2 | form of a vaccine. | |
| _ | | |
| 1 | 71. | A method for eliciting or enhancing an immune response to HER- |
| 2 | 2/neu protein, the me | thod comprising the step of administering to a warm-blooded animal |
| 3 | the nucleic acid mole | ecule of claim 58 in an amount effective to elicit or enhance the |
| 4 | immune response. | |
| | - | |
| 1 | 72. | The method of claim 71, wherein the nucleic acid molecule is in |
| 2 | the form of a vaccine | e |
| | | |
| 1 | 73. | The method of claim 71, wherein the step of administering |
| 2 | - | ng cells of the warm-blooded animal ex vivo with the nucleic acid |
| 3 | molecule and subseq | uently delivering the transfected cells to the warm-blooded animal. |
| | | A south of the clinities or enhancing an immune response to HER- |
| 1 | 74. | A method for eliciting or enhancing an immune response to HER- |
| 2 | | ethod comprising the step of administering to a warm-blooded animal |
| 3 | the viral vector of cla | aim 59 in an amount effective to elicit or enhance the immune |
| 4 | response. | |

| | . 1 |
|---------------------|--|
| 1 | 75. The method of claim 74, wherein the step of administering |
| 2 | comprises infecting cells of the warm-blooded animal et vivo with the viral vector and |
| 3 | subsequently delivering the infected cells to the warm-blooded animal. |
| 1 | 76. A method for inhibiting the development of a cancer in a patient, |
| 2 | the method comprising the step of administering to a patient an effective amount of a |
| 3 | fusion polypeptide according to claim 1, 26, or 51 and thereby inhibiting the developmen |
| 4 | of a cancer in the patient. |
| 1 | 77. A method for inhibiting the development of a cancer in a patient, |
| 2 | the method comprising the step of administering to a patient an effective amount of a |
| 3 | polynucleotide according to claim 8, 33, or 58 and thereby inhibiting the development of |
| 4 | a cancer in the patient. |
| 1 | 78. A method for inhibiting the development of a cancer in a patient, |
| \int_{0}^{1} | the method comprising the step of administering to a patient an effective amount of an |
| R | antigen-presenting cell that expresses a fusion polypeptide according to claim 1, 26, or |
| \int_{4}^{∞} | 51, and thereby inhibiting the development of a cancer in the patient. |
| 1 | 79. A method according to claim 78, wherein the antigen-presenting |
| 2 | cell is a dendritic cell. |
| 1 | 80. A method according to any one of claims 76-79, wherein the |
| 2 | cancer is breast, ovarian, colon, lung or prostate cancer. |
| 1 | 81. A method for removing tumor cells from a biological sample, the |
| 2 | method comprising the step of contacting a biological sample with T cells that |
| . 3 | specifically react with a HER-2/neu fusion protein, wherein the fusion protein comprises |
| 4 | an amino acid sequence that is encoded by a polynucleotide sequence selected from the |
| 5 | group consisting of: |
| 6 | (i) polynucleotides recited in any one of SEQ ID NO:8, 33, or |
| 7 | 58; and |
| 8 | (ii) complements of the foregoing polynucleotides; |
| 9 | wherein the step of contacting is performed under conditions and for a |
| 10 | time sufficient to permit the removal of cells expressing the antigen from the sample. |

| | | | 1 |
|----------------|---------------------|--------------------------------|--|
| 1 | . 8 | 2. A me | thod according to claim 8/1, wherein the biological sample is |
| 2 | blood or a fraction | on thereof. | |
| | | _ | |
| 1 | | | thod for inhibiting the development of a cancer in a patient, |
| 2 | comprising the s | step of admi | nistering to a patient a biological sample treated according to |
| 3 | the method of cl | aim 81. | |
| 1 | 8 | 4.' A me | thod for stimulating and/or expanding T cells specific for a |
| 2 | HER-2/neu fusion | on protein, t | he method comprising the step of contacting T cells with one |
| 3 | or more of: | | |
| 4 | (| i) a fusi | on protein according to claims 1, 26, or 51; |
| 5 | (| ii) a poly | nucleotide encoding such a fusion protein; or |
| 6 | (| iii) an an | tigen presenting cell that expresses such a fusion protein; |
| 17 | u | ınder conditi | ions and for a time sufficient to permit the stimulation and/or |
| V ₈ | expansion of T | cells. | |
| 1 | 8 | 5. An is | olated Teell population, comprising T cells prepared |
| 2 | according to the | method of | claim 84. |
| | | | |
| 1 | | | thod for inhibiting the development of a cancer in a patient, |
| 2 | the method com | prising the | step of administering to a patient an effective amount of a T |
| 3 | cell population | according to | claim 85. |
| 1 | 8 | 37. A me | thod for inhibiting the development of a cancer in a patient, |
| 2 | the method com | prising the | steps of: |
| 3 | (| (a) incub | pating CD4 ⁺ and/or CD8+ T cells isolated from a patient with |
| 4 | at least one con | nponent sele | cted from the group consisting of: |
| 5 | | (i) | a fusion protein according to claims 1, 26, or 51; |
| 6 | | (ii) | a polynucleotide encoding such a fusion protein; and |
| 7 | | (iii) | an antigen-presenting cell that expresses such a fusion |
| 8 | protein; | , | |
| 9 | s | such that \mathbf{T}_{k}^{J} | cells proliferate; and |
| 10 | (| (b) admi | nistering to the patient an effective amount of the proliferated |
| 11 | T calls thereby | inhihiting t | he development of a cancer in the patient. |

| 1 | 88. | A method for inhibiting the development of a cancer in a patient, | |
|-----|---|--|--|
| 2 | the method comprising the steps of: | | |
| 3 | (a) | incubating CD4 ⁺ and/or CD8 ⁺ T cells isolated from a patient with | |
| 4 | at least one component selected from the group consisting of: | | |
| 5 | | (i) a fusion protein according to claims 1, 26, or 51; | |
| 6 | | (ii) a polynucleotide en oding such a fusion protein; and | |
| 7 | | (iii) an antigen-presenting cell that expresses such a fusion | |
| 8 | protein; | | |
| 9 | such | that T cells proliferate; | |
| 10 | (b) | cloning at least one proliferated cell; and | |
| 11 | (c) | administering to the patient an effective amount of the cloned T | |
| 12 | cells, thereby inhibiting the development of a cancer in the patient. | | |
| 1 | 89. | A method of making a fusion protein according to claims 1, 26, or | |
|) 2 | 51, the method comp | prising the steps of: | |
| 3 | (a) | introducing into a cell an expression vector comprising a | |
| 4 | polynucleotide accor | rding to claims 8, 3, or 58; | |
| 5 | (b) | culturing the transfected cell; and | |
| 6 | (c) | purifying the expressed protein. | |
| 1 | 90. | The method of claim 89, wherein the cell is a CHO cell. | |
| 1 | 91. | The method ϕ f claim 89, wherein the cell is cultured in suspension, | |
| 2 | under serum-free co | nditions. | |
| 1 | 92. | The method of claim 89, wherein the expressed protein is purified | |
| 2 | by a two-step proceed | dure, the procedure comprising: | |
| 3 | (a) | anion exchange chromatography on Q sepharose High Performance | |
| 4 | Columns; and | _ | |
| 5 | (b) | hydrophobic chromatography on Phenyl Sepharose 6 Fast Flow | |
| 6 | low substitution. | · . | |

